

Video Object Extraction for Surveillance System

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Reference

1. C. Kim and J.-N. Hwang, “Object-based video abstraction for video surveillance systems”, *IEEE Transactions on Circuits and Systems for Video Technology*, vol.12, no. 12, pp. 577-586, Dec. 2002.
2. S. Chien, S. Ma, and L.-G. Chen, “Efficient moving object segmentation algorithm using background registration Technique”, *IEEE Transactions on circuits and systems video technology*, vol.12, pp. 577-586, July 2002.
3. R. Cucchiara, C. Grana, M. Piccardi, and A. Prati, “Detecting moving objects, ghosts, and shadows in video streams”, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 25, no. 10, pp. 1337-1341, Oct. 2003

Outline

- Introduction
- Previous researches
- Traditional pixel-based approach
- Object-based background update
- Proposed efficient object extraction method
- Experiment results

Market for video surveillance system

- **Commercial Applications**
 - Monitoring possible crimes in parking lot, bank, or office
 - Detecting accidents on highway
 - Measure traffic flow
 - Monitoring consumers in supermarkets and shopping malls
 - Counting endangered animals
- **Military applications**
 - Monitoring national borders
 - Measuring the flow of refugees in troubled areas
 - Providing security perimeters around bases and embassies

Aerial surveillance

Commercial Product Sample



Major Features:

- Simple motion detection
- Multiple camera support
- Timer schedule
- ROI selection
- Remote monitoring

Challenges for Object Detection

- Light changes
- Background changes (car moves in/out)
- Slight environment changes
- Shadow effect

—————▶ Video object segmentation/extraction

Video Object Extraction

Original Frame



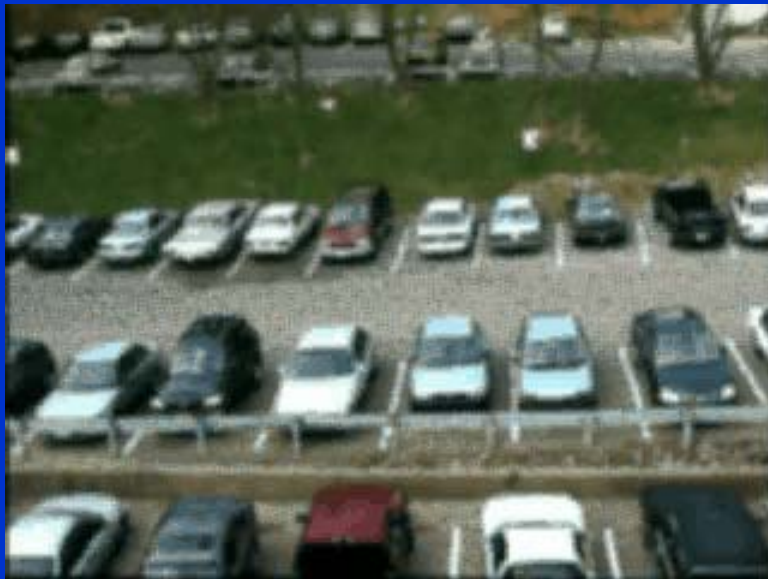
Background



Object

VSAM by CMU

Video Surveillance and Monitoring System
Developed by Carnegie Mellon University, 2000



VSAM by CMU

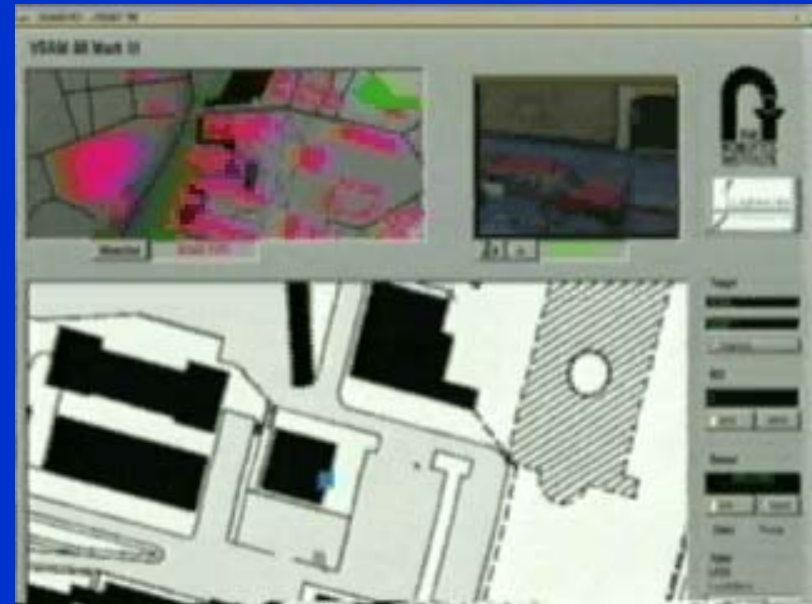
Trajectory Tracking Demo



VSAM by CMU



Traditional Monitoring Screen

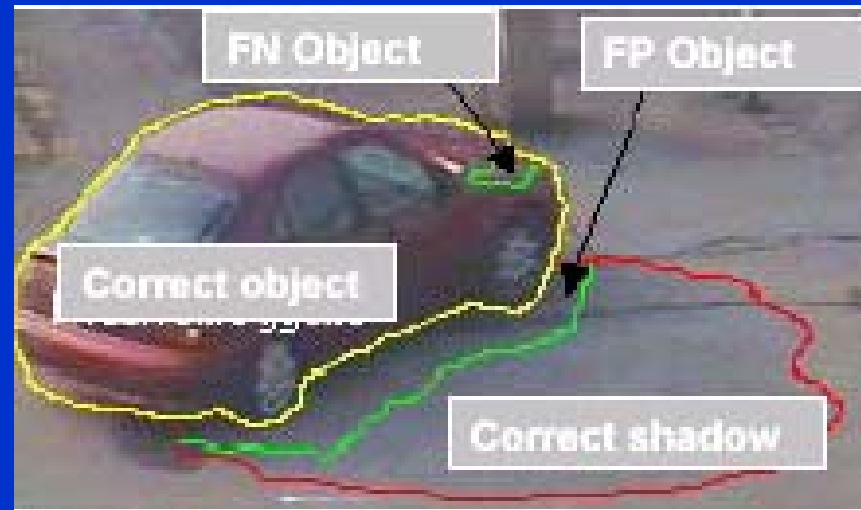


Automatic Monitoring Interface by VSAM

Sakbot System

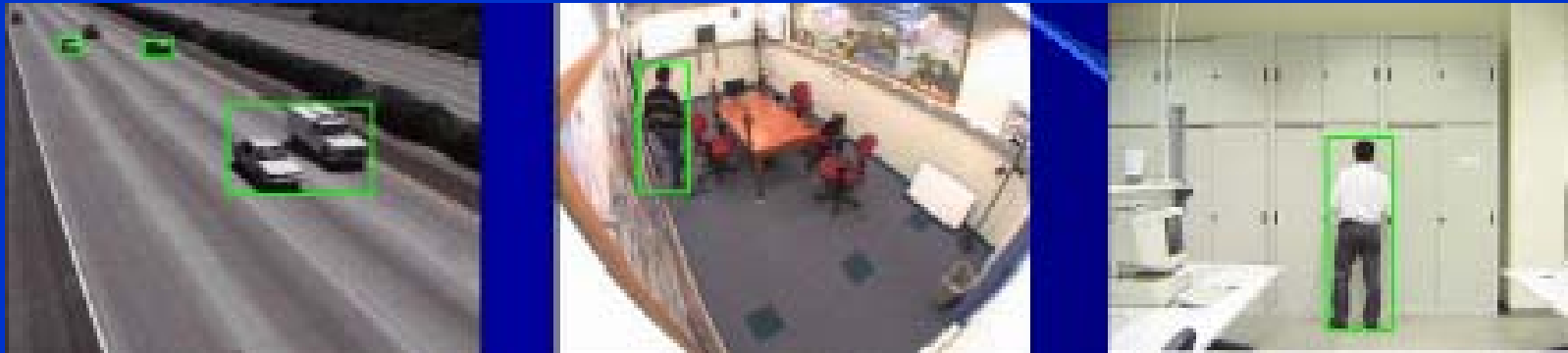
Developed by University of Mondena, Italy, 2003.

Emphasis on Shadow Detection

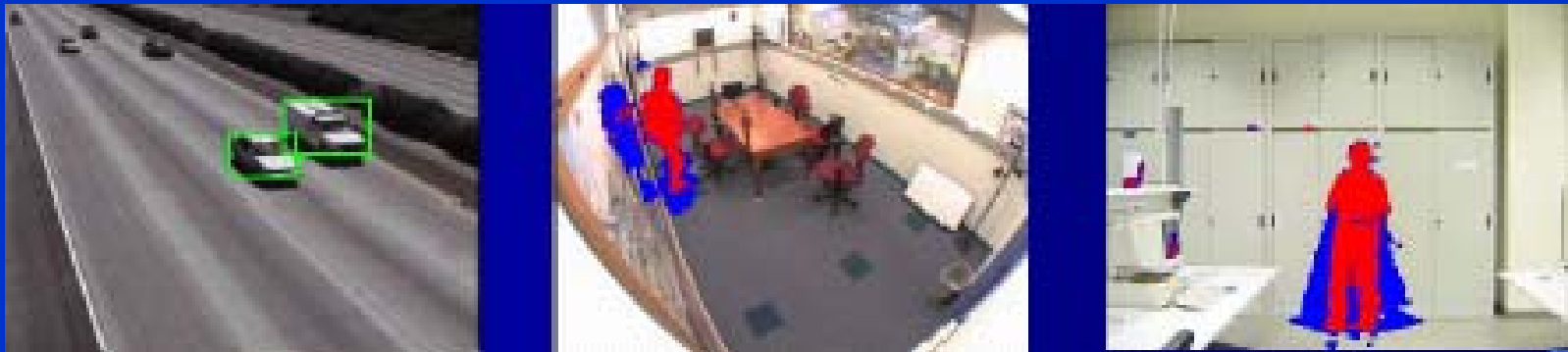


Sakbot System

Without Shadow Detection



With Shadow Detection



Drawbacks



← Ghost

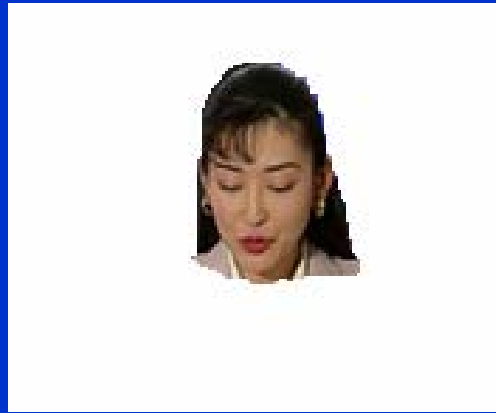


Original Frame

Relationship between Moving Pixels and Object



Original Frame

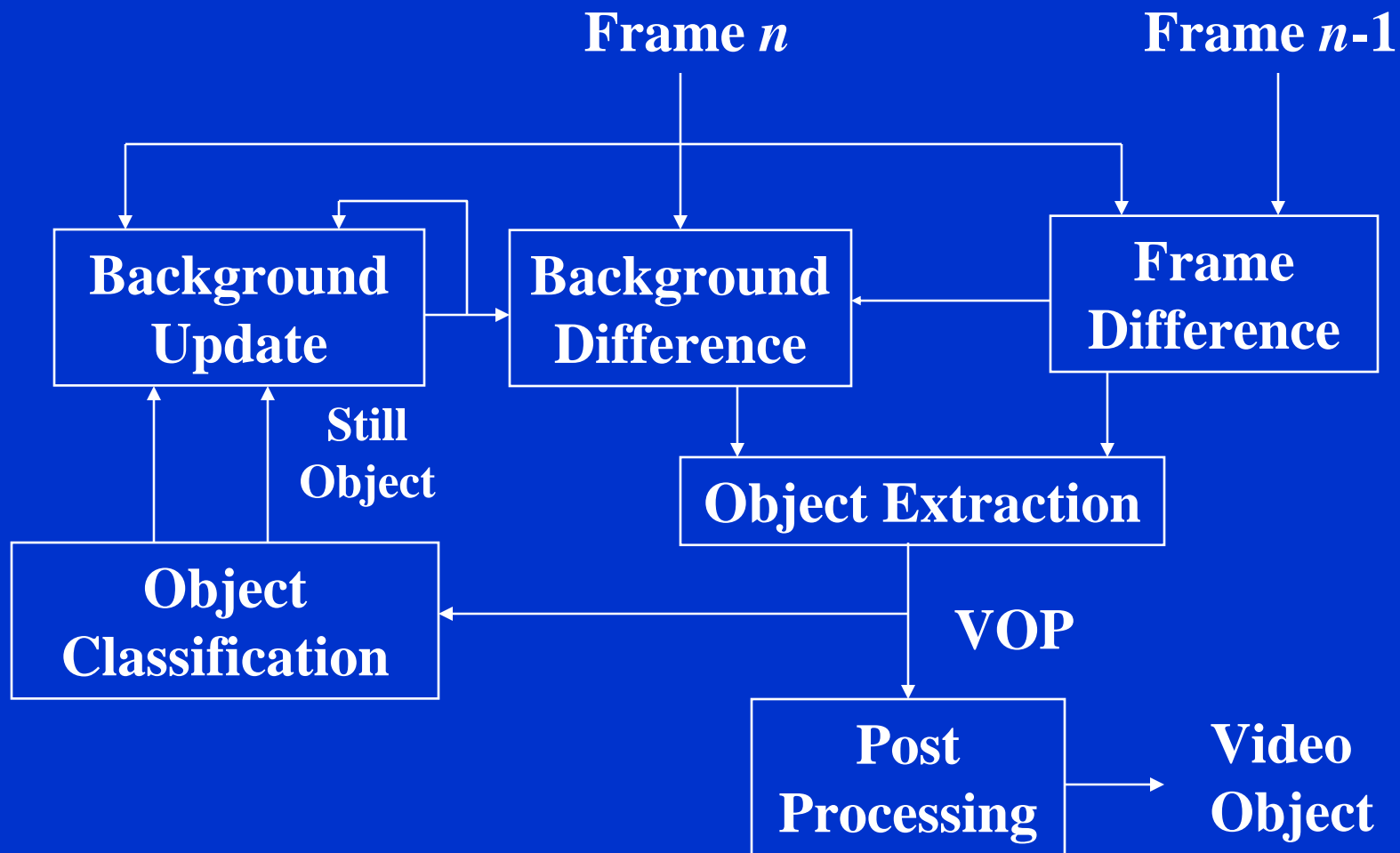


Moving pixels



Moving Object

Object-based Approach

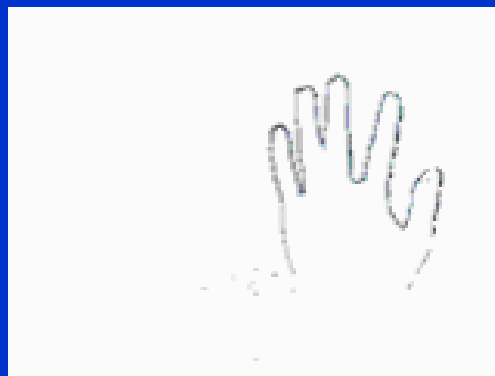


Pixel Difference V.S. Edge Difference

Pixel Difference



Edge Difference



Edge-based Object Extraction



Current Frame



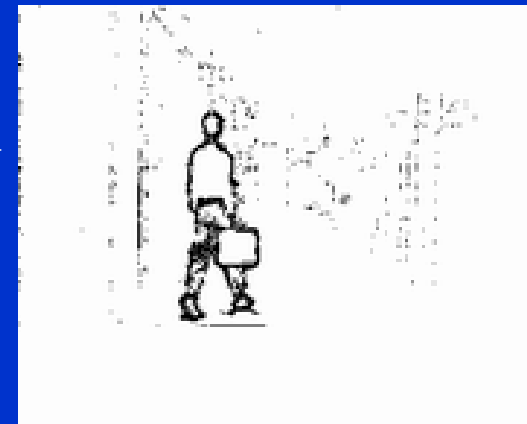
Frame Edges



Background Frame

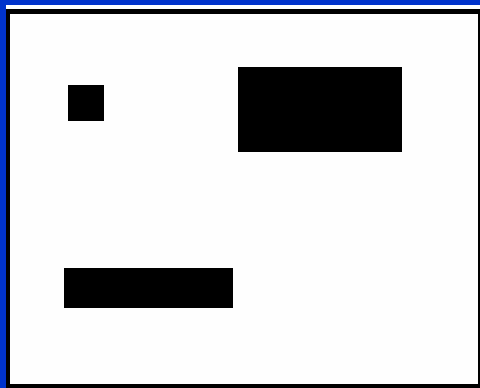


Background Edges

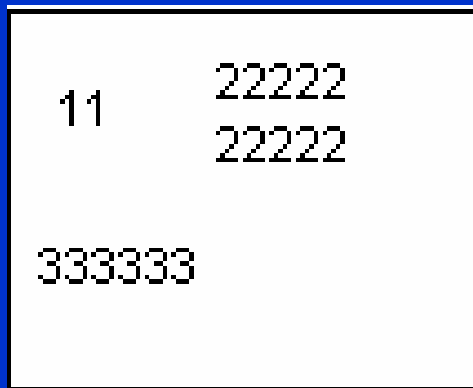


Object boundary

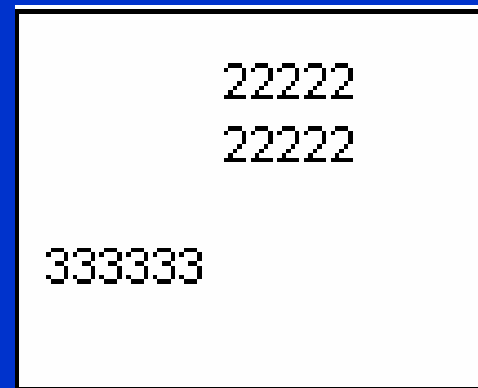
Noise Removal and Object Identification by Connected Component Analysis



↑
Extracted
Objects

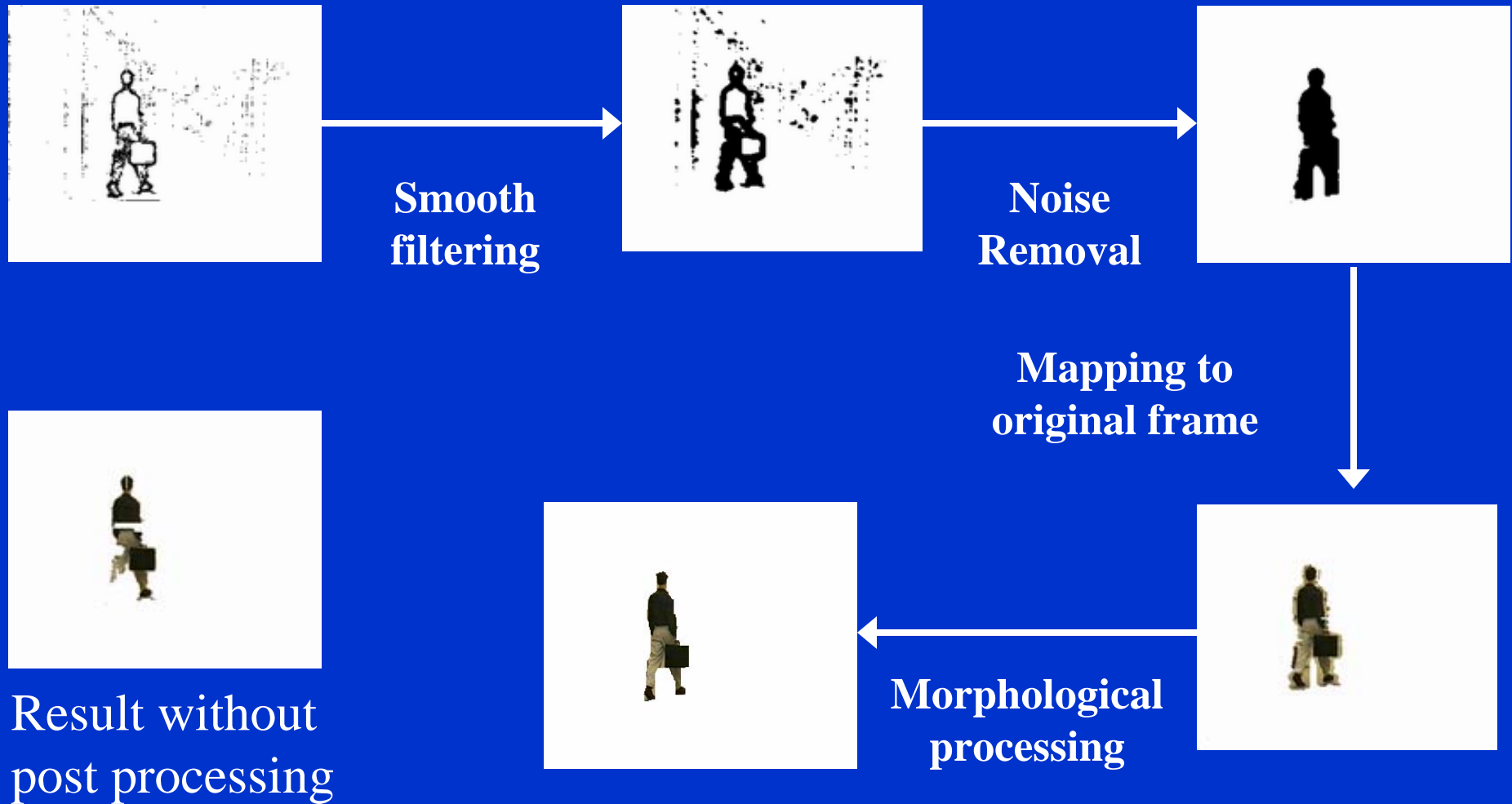


↑
Object
Labeling



↑
Noise
Removal

Post Processing



Moving Object Detection

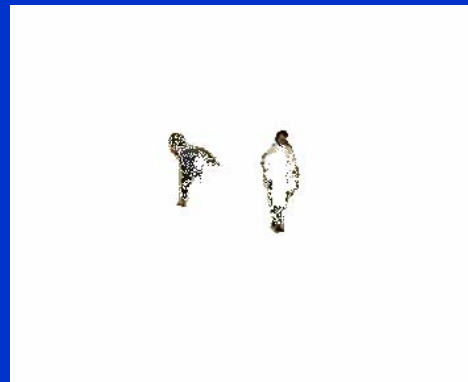
**Extracted
Object**



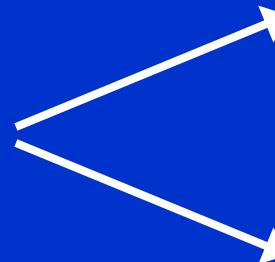
**Moving
Object**



**Consecutive
Frame
Difference**



**Still
Object**



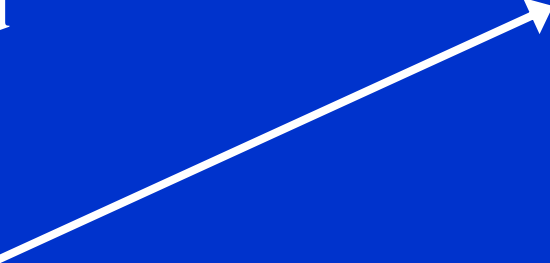
Background Update



Original Background



Still Object



Stable for N frames



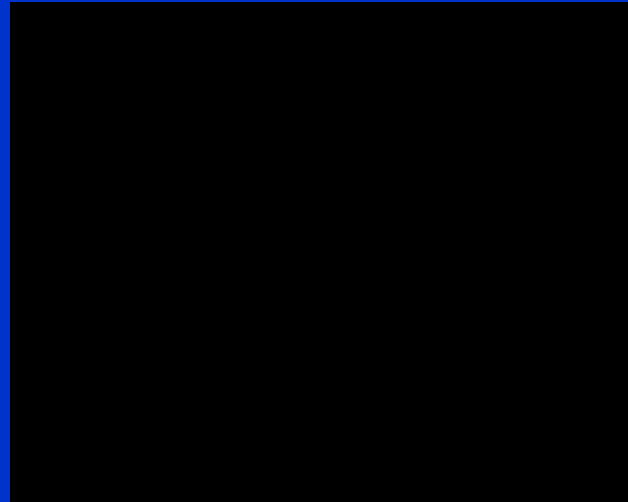
Updated Background

Extraction Result

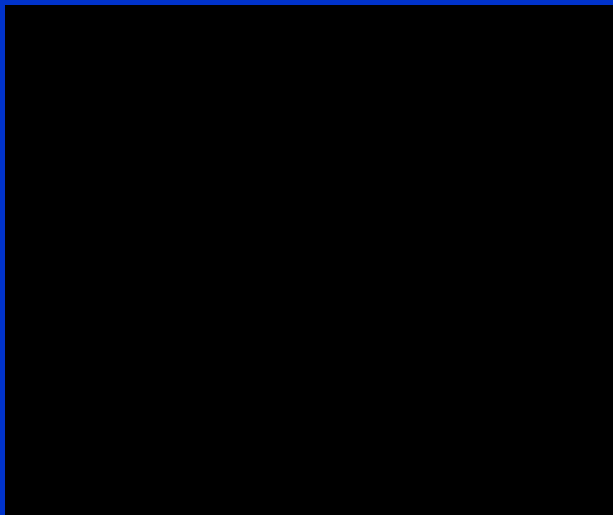
Original
Video



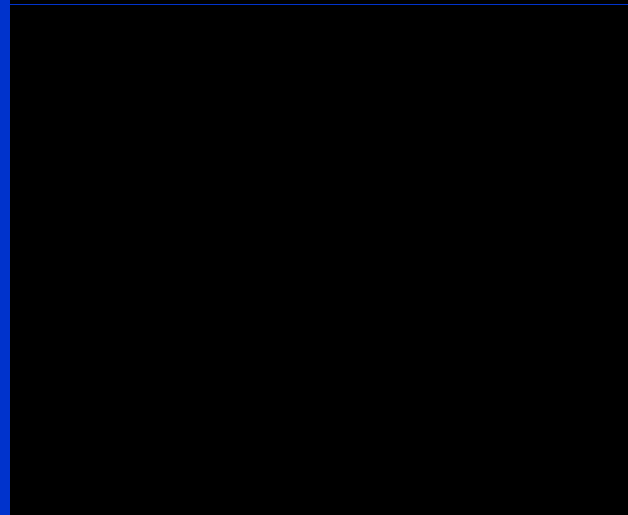
Video
Object



Background



Playback

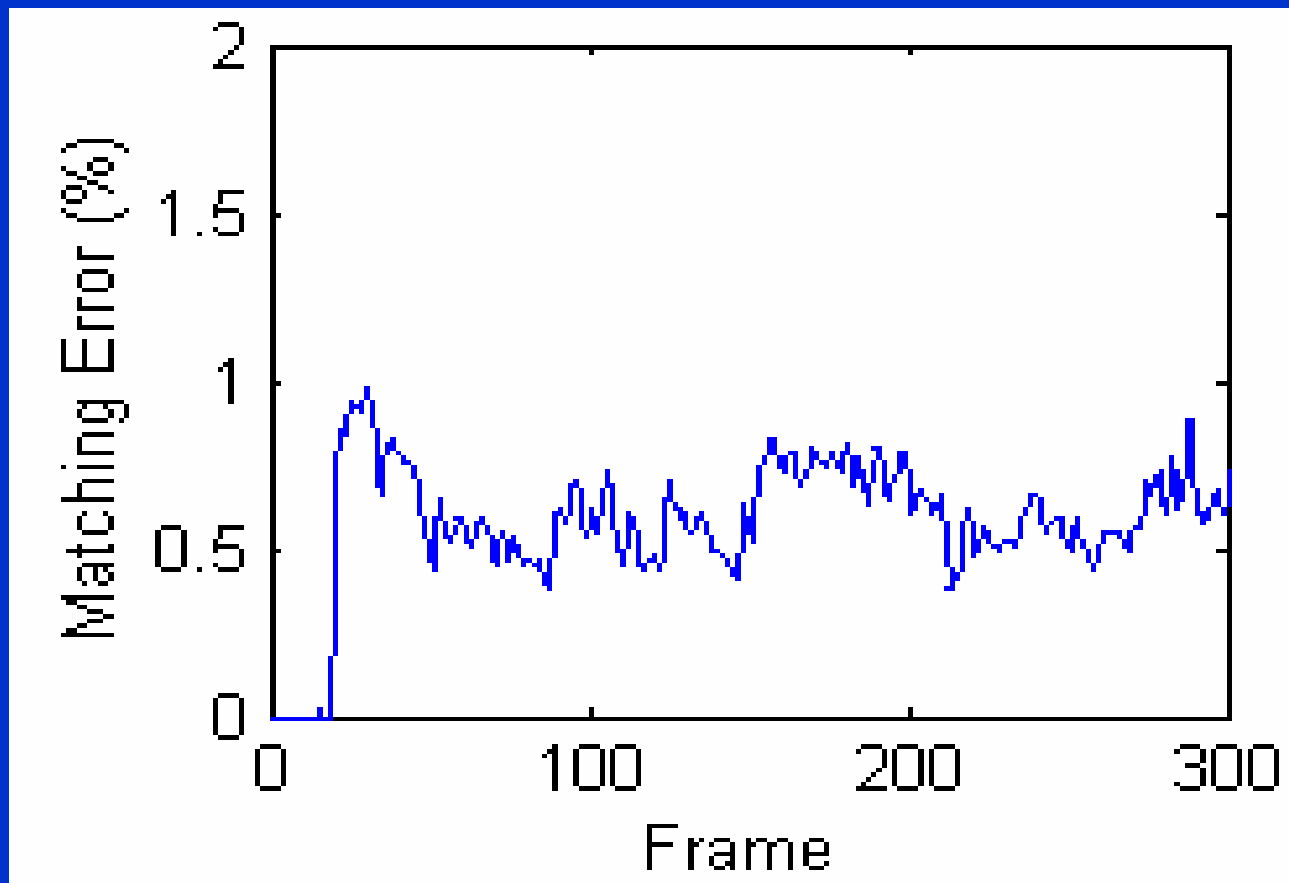


Matching Error

Matching Error: The accuracy of extracted object comparing with the standard object mask (extracted manually)

$$Em = \frac{1}{NM} \sum_{k=1}^N \sum_{l=1}^M |T_{kl} - O_{kl}|$$

Extraction Accuracy



Shadow Elimination by Edge Detection



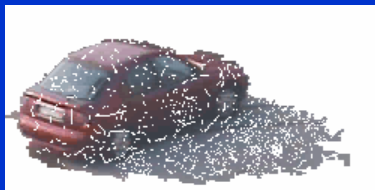
Original Frame



Object



YUV based



HSV based



RGB based



Edge based

Background Update and Object Extraction

Initial
Background



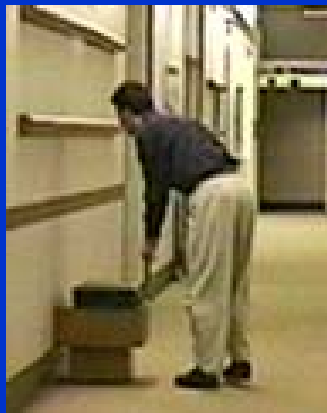
Frame
100



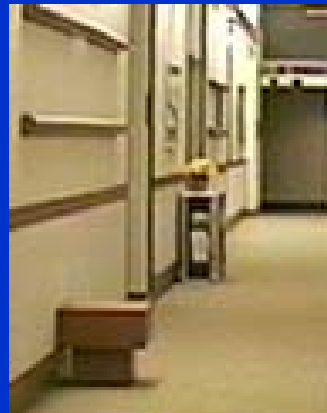
Frame
110



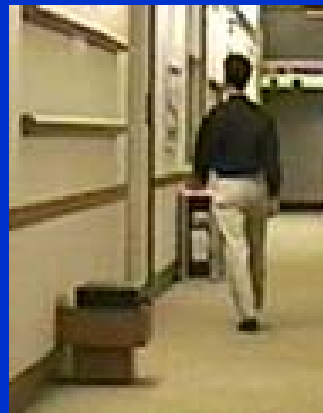
Detection of Abandoned Object



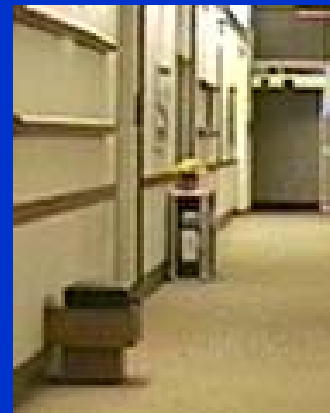
(a)



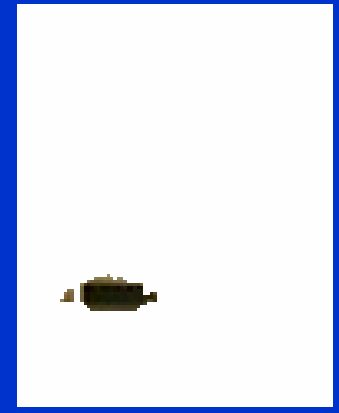
(b)



(c)



(d)



(e)

(a) Frame 135. (b) Background of Frame 135, the suitcase is not there yet.
(c) Frame 210. (d) Background of Frame 210. (e) Alarm is issued at
Frame 210

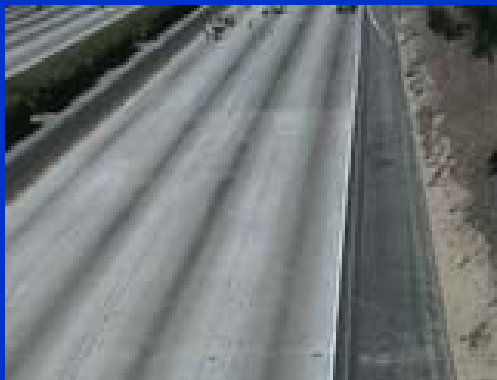
Highway Monitoring



Frame 1 (Initial background)



Frame 110



Updated Background



Extracted Object

THANK YOU!